

**CLAIMS**

What is claimed is:

1. A rotary tool holder for detachably retaining a rotary tool in a tapered bore of a spindle, the rotary tool holder comprising:
  - a shank having a tapered outer surface corresponding to the tapered bore, the shank having a front contact portion and a rear contact portion;
  - 5 a flange adjacent the front contact portion;
  - a first circular cantilever adjacent one of the front and rear contact portions, the first circular cantilever having a fixed end and a free end; and
  - wherein rotation of the rotary tool holder when disposed in the spindle results in the free end of the first circular cantilever expanding radially under the influence of
  - 10 centrifugal force such that the free end maintains contact with the tapered bore which also radially expands under the influence of centrifugal force during rotation.
2. The rotary tool holder of claim 1 wherein the circular cantilever is elastically deformable to maintain contact with the tapered bore.
3. The rotary tool holder of claim 1 further comprising an annular recessed region in the tapered outer surface, the annular recessed region located intermediate the front and rear contact portions.
4. The rotary tool holder of claim 1 further comprising:
  - a cavity formed in a rear face of the shank, the cavity having an exterior surface forming at least part of the first circular cantilever;
  - a pull stud having a first end captured in the cavity and a second end external
  - 5 of the cavity, the second end adapted to have tension applied thereto after the rotary tool holder is positioned in the spindle; and
  - wherein the tension on the second end causes the first end to apply an outward radial force on the cavity which urges the exterior surface in a radially outward direction toward the tapered bore when the shank is positioned therein.

5. The rotary tool holder of claim 4 further comprising an annular recessed region in the tapered outer surface, the annular recessed region located intermediate the front and rear contact portions.

6. The rotary tool holder of claim 4 further comprising:  
the cavity having an interior surface portion which tapers from a wider region of the cavity to a narrower region thereof forming a bottle neck;

the first end of the pull stud tapering from a larger distal portion captured in  
5 the wider region of the cavity to a narrower neck which extends through the narrower region of the cavity; and

wherein tension applied to the second end acts to draw the larger distal portion from the cavity which urges the narrower region of the in the radially outward direction.

7. The rotary tool holder of claim 1 further comprising:

a second circular cantilever having the free and fixed ends, the second circular cantilever located adjacent the front contact portion with the free end thereof extending toward the flange;

5 the first circular cantilever located adjacent the rear contact portion with the free end thereof extending toward a rear face of the shank; and

wherein rotation of the rotary tool holder in the spindle results in the free end of each of the first and second circular cantilevers expanding radially under the influence of centrifugal force such that the free ends maintain contact with the tapered  
10 bore which also expands under the influence of centrifugal force during the rotation.

8. The rotary tool holder of claim 1 wherein the shank further comprises:  
an inner member; and

a sleeve member disposed over the inner member, the sleeve member having the tapered outer surface and a first end, a first portion of the first end forming the  
5 first circular cantilever having the free and fixed ends, the free end spaced apart from the inner member.

9. The rotary tool holder of claim 8 further comprising an annular recessed region in the tapered outer surface of the sleeve member intermediate the front and rear contact portions of the shank.

10. The rotary tool holder of claim 8 further comprising:  
the sleeve member having a second end, and a second portion of the second end forming a second circular cantilever having the free and fixed ends, the free end spaced apart from the inner member;

5 the second portion of the sleeve member positioned adjacent the front contact portion of the shank with the free end of the second circular cantilever extending toward the flange;

the first portion of the sleeve member positioned adjacent the rear contact portion of the shank, the free end of the first circular cantilever extending toward a  
10 rear face of the shank; and

wherein rotation of the rotary tool holder in the spindle results in the free end of each of the first and second circular cantilevers expanding radially under the influence of centrifugal force such that the free ends maintain contact with the tapered bore which also expands under the influence of centrifugal force during the rotation.

11. The rotary tool holder of claim 10 further comprising an annular recessed region in the tapered outer surface of the sleeve member intermediate the first and second portions thereof.

12. The tool holder of claim 8 further comprising:  
the inner member having an outside mating surface, the outside mating surface having a tapered portion and a generally cylindrical portion; and

5 the sleeve member having an inside mating surface, the inside mating surface having a tapered portion corresponding to the tapered portion of the outside mating surface, and the free end of the first circular cantilever being spaced apart from the generally cylindrical portion of the outside mating surface.

13. The tool holder of claim 10 further comprising:

the inner member having an outside mating surface, the outside mating surface having generally cylindrical portions at each of the front and rear contact portions of the shank and a tapered portion intermediate the generally cylindrical portions; and

- 5 the sleeve member having an inside mating surface, the inside mating surface having a tapered portion corresponding to the tapered portion of the outside mating surface, and the free end of the each of the first and second circular cantilevers being spaced apart from the generally cylindrical portions of the outside mating surface.

14. The tool holder of claim 8 further comprising:

the inner member having a stepped outer surface, the stepped outer surface having a plurality of generally cylindrical portions, each of the plurality of generally cylindrically portions increasing in diameter from a smaller diameter at the rear

- 5 contact portion of the shank to a larger diameter at the front contact portion thereof;

the sleeve member having a stepped bore, the stepped bore having a plurality of generally cylindrical regions, each of the plurality of generally cylindrical regions increasing in diameter from a smaller diameter at the rear contact portion of the shank to a larger diameter at the front contact portion thereof; and

- 10 wherein the at least a portion of the generally cylindrical portions of the stepped outer surface mate with at least part of the plurality of generally cylindrical regions of the stepped bore when the sleeve member is disposed over the inner member.

15. The rotary tool holder of claim 14 wherein the plurality of generally cylindrical portions further comprises four generally cylindrical portions, the plurality of generally cylindrical regions further comprises three generally cylindrical regions, and at least part of two of the four generally cylindrical portions of the stepped outer surface mate with at least part of two of the three generally cylindrical regions of the

- 5 stepped bore.

16. A rotary tool holder for detachably retaining a rotary tool in a tapered bore of a spindle, the rotary tool holder comprising:

a shank having a tapered outer surface corresponding to the tapered bore, the shank having a front contact portion and a rear contact portion;

- 5           a flange adjacent the front contact portion;  
          a first circular cantilever adjacent the front contact portion, the first circular  
          cantilever having a fixed end and a free end, the free end extending toward the flange;  
          a second circular cantilever adjacent the rear contact portion, the second  
          circular cantilever having the free and fixed ends, the free end extending toward a rear  
10   face of the shank; and  
          wherein rotation of the rotary tool holder when disposed in the spindle results  
          in the free end of each of the first and second circular cantilevers expanding radially  
          under the influence of centrifugal force such that the free ends maintain contact with  
          the tapered bore which also expands under the influence of centrifugal force during  
15   the rotation.

17.    The rotary tool holder of claim 16 wherein the circular cantilever is  
          elastically deformable under the influence of centrifugal force during rotation such  
          that during rotation the free end radially expands to maintain contact with the tapered  
          bore.

18.    The rotary tool holder of claim 16 wherein the shank further  
          comprises:

- an inner member; and  
          a sleeve member disposed over the inner member, the sleeve member having  
5   the tapered outer surface, a first end and a second end;  
          the first end having a first portion forming the first circular cantilever having  
          the free and fixed ends, the free end spaced apart from the inner member; and  
          the second end having a second portion forming the second circular cantilever  
          having the free and fixed ends, the free end spaced apart from the inner member.

19.    The rotary tool holder of claim 18 further comprising an annular  
          recessed region in the tapered outer surface of the sleeve member intermediate the  
          front and rear contact portions of the shank.

20.    A rotary tool holder for detachably retaining a rotary tool in a tapered  
          bore of a spindle in which the tapered bore has a taper defined by a front diameter and

a rear diameter which is smaller than the front diameter, and wherein the front and rear diameters each change at different rates under the influence of centrifugal force  
5 when the spindle is rotated such that the tapered bore has a different taper at different speeds of rotation, the rotary tool holder comprising:

a shank having a tapered outer surface, the tapered outer surface having a taper defined by a first diameter and a second diameter which is smaller than the first diameter, the first and second diameters each changing at different rates under the  
10 influence of centrifugal force when the shank is rotated in the spindle such that the tapered outer surface has a different taper at different speeds of rotation;

the first diameter generally corresponding to the front diameter of the tapered bore when disposed therein and the spindle is rest; and

wherein the second diameter is selected to cause the tapered outer surface to  
15 have an optimized taper when the shank is disposed in the spindle and rotated within a certain range of speeds, the optimized taper substantially corresponding to a taper of the tapered bore within the certain range of speeds such that improved contact between the tapered outer surface and the tapered bore results within the certain range of speeds.

21. The rotary tool holder of claim 20 wherein the circular cantilever is elastically deformable to maintain contact with the tapered bore.

22. The rotary tool holder of claim 20 further comprising an annular recessed region in the tapered outer surface of the tool holder intermediate the front and rear contact portions of the tool holder.